A Revision of the Australian Cyclostrematidæ and Liotiidæ.

By Professor Ralph Tate.

[Read September 5, 1899.]

Plates VI., VII.

This communication was submitted to this Society, August 2, 1898, but by reason of inability to prepare illustrations in time for issue in the volume for 1898, its publication was deferred. A brief abstract appears, however, on p. 239 of that volume, and therein is established the generic names *Cyclostremella* and *Pseudoliotia*. In the interval some additional information has been collected or published, notably the illustrations of *Liotia Lodderæ* by Mr. Hedley, and that five speeies of *Cyclostrema* and one of *Liotia* have been elaborated by Dr. Verco, the diagnoses of which, and accompanying illustrations in a published form, are deferred till his return from Europe; also, my attention has been drawn by Mr. Hedley to a paper by Miss Bush on "A Revision of *Cyclostrema* and Related Genera belonging to the Atlantic Fauna of America" (Trans. Connecticut Acad., 1897), wherein a new genus *Cyclostremella* is founded, which necessitates a new name for the genus typefied by *Liotia Lodderæ*.

The limits of the genera *Cyclostrema* and *Liotia* are not so exact as to permit in all cases of a safe reference to one or the other.

The conchological characters largely relied on for *Cyclostrema* are a thin vitreous test, entire, simple non-varicosed aperture, and a multispiral operculum. For *Liotia*, a stout perlaceous test, last whorl descending at the front, aperture varieed and entire, operculum spiral and covered with calcareous granules. As to the animal, that of *Liotia* is only known, and to the following extent: "does not possess intertentacular lobes, but the foot is furnished with lateral filaments, as in Trochidæ" (A. Adams, in P.Z.S., 1863).

As a result of a study of the larger number of Australian species embraced in the families Cyclostrematidæ and Liotiidæ, I find that several species have been wrongly assigned to their respective families. Thus, for instance, *Cyclostrema micans* and *Liotia Angasi* have solid shells, with an entire aperture, but not distinctly varicosed; by comparison of types in the British Museum, they are one and the same species, and as the test is

not pearly inside the family reference should be to *Cyclostrematidæ*, a position confirmed by my personal knowledge of its operculum. Another species of dubious generic location is *Liotia Lodderæ*, which, because of its thickened aperture, has a Liotia-like aspect; but its vitreous test, in the absence of other characters, makes it desirable to relegate it also to *Cyclostrematidæ*.

Having applied the above-mentioned conchological tests to many of our reputed species of these two families, I hope that my verdicts thereon may facilitate the preparation of a complete revision of them.

FAMILY CYCLOSTREMATIDÆ.

Cyclostrema is a heterogeneous assemblage of species, embracing such divergent characters as—

1. TEXTURE—*a*, porcellonous and thick, as in *C. micans*; *b*, translucent and thin, as in *C. Tatei*.
2. SHAPE—*a*, turbinate, as *C. tenera*, Jeffreys, and *C. conica*, Watson; *b*, discoid, as *C. nivea*, A. Ad.; *c*, planorbiform, as *C. cyclotina*, A. Ad.
3. APERTURE—*a*, simple, as in *C. Tatei*; *b*, thickened, as in *C. micans*; *c*, varicosely margined, as in *C. Lodderæ*.
4. UMBILICUS—*a*, wide in *C. Tatei*; *b*, almost obliterated in *C. micans*.
5. PERITREME continuous or incomplete.

These multifarious elements indicate that *Cyclostrema*, in an extended sense, is heterogeneously composed, and in my treatment of the Australian species I have endeavoured to arrange them in genera and sections best in accord with morphological characteristics—anatomical features still remain unascertained; nevertheless, I have added difficulties by the inclusion of three species of doubtful classificatory position.

GENUS CYCLOSTREMA, *Marryatt*, 1818.

Shell depressed; test thin, hyaline, usually spirally lined or ridged; aperture simple; umbilicus open.

The genus *Vitrinella*, C. B. Adams, does not appear to me to be distinct from the typical Cyclostrematids.

SECTION CYCLOSTREMA, *s. s.*

The characters of the genus.

SECTION TUBIOLA, *A. Adams*, 1864.

Shell turbinate; thin, opaque-white, and usually inornate.

The genus *Cirsonella*, Angas, which was placed provisionally by its author among Trochidæ, is, in my opinion, reducible to this section. Fischer, Man. Conch., and Tryon, Man. Conch., X., p. 16, place it subgenerically under *Tinostoma*. *Tinostoma* is not considered by me a member of the family.

Genus Lodderia, *Tate*, 1899.

Differs from *Cyclostrema*, *s. s.*, by its varicosely margined aperture. Type: *Liotia Loddercæ*, Petterd.

Genus Pseudoliotia, *Tate*, 1898.

Shell somewhat like *Liotia;* test thick and porcellanous; aperture oblique to the axis, its margin thickened; umbilicus reduced to a mere chink; operculum horny, multispiral. Type: *Cyclostrema micans*, A. Adams; it recalls *Mölleria*, which is differentiated by a calcareous operculum. Judging from published figure and description, *Cyclostrema eburnea*, Nevill, is congeneric.

CATALOGUE OF THE AUSTRALIAN CYCLOSTREMATIDÆ.

Genus Cyclostrema, *s. s.*

1. Cyclostrema Tatei, *Angas.* P.Z.S., 1878, p. 862, t. 54, fig. 10.

The ornamentation of the the shell of this species varies from eight spiral ribs to nearly smooth. The many keeled form resembles *C. cingulifera*, A. Adams, whilst the smooth form simulates *C. lævis*, Kiener. Reeve, in his Monograph of the genus records these Japanese species as also from Port Lincoln. My comparison of *C. Tatei* with the British Museum examples of *C. cingulifera* leaves me in doubt of their specific identity, chiefly on account of the very large size of the Japanese shells. Until Mr. Edgar Smith has given his opinion on the question, which he kindly promised to do, I shall expunge *C. cingulifera* and *C. lævis* from the South Australian fauna, as I tentatively regard Reeve's Australian reference to belong to *C. Tatei.*

The species is confined to St. Vincent Gulf, and the coast to the westward thereof. (*R. Tate*).

2. Cyclostrema Harriettæ, *Petterd.* Journ. Conch., p. 141 (1884).

This Tasmanian species, types of which I have had under comparison, is closely related to *C. Tatei*, but differs by its regularly disposed spiral threads, transversely and closely striated (not oblique and distant), depressed spire, and by the subtruncate periphery of the last whorl. Also Holdfast Bay, S. Australia (*R.T.*).

3. Cyclostrema Johnstoni, *Beddome.* Proc. Roy. Soc., Tasmania, for 1882, p. 168 (1883). Pl. vii., figs. 7 *a-b.*

A depressed shell, ornamented with sharp elevated transverse ribs (about 35 on body-whorl), intercostal spaces without sculpture; aperture entire, not thickened.

It is very like *C. Archeri*, Tryon. Man. X., p. 89, t. 33, fig. 84, 1888, but "peristome thickened" does not apply, though his figure does not portray that character. The species belongs to Tasmania.

Cyclostrema inscriptum, *spec. nov.* Pl. vii., figs. 3 *a-b*.

Shell minute, very fragile, discoidal, diaphanous, widely umbilicated. Spire flat, not rising above the plane of the last whorl. Whorls four, convex, with a gentle antesutural slope; surface smooth and shining, but incremental striæ are visible under a pocket-lense. Aperture roundly oval, a little wider than high; peristome incomplete.

Dimensions of figured example.—Major diameter, 2·2; minor diameter, 1·6; height, 1·2 mm.

Locality.—West coast of South Australia.

This species differs from the smooth form of *C. Tatei* by its flat spire, the last whorl relatively less high, and by the absence of spiral ornament; it has not the compact build or sunken spire of *C. charopa*.

Cyclostrema delectabile, *spec. nov.* Pl. vii., fig. 4.

Shell small, thin, translucent white, subdiscoidal. Spire slightly elevated; widely and perspectively umbilicated. Protoconch globulose and hyaline. Ordinary whorls three, of rather rapid increase; ornamented by rounded spiral and axial threadlets, which on the antesutural slope are of about equal strength and equidistant, producing a reticulation of square meshes; on the rounded periphery the spiral riblets are dominant as far as the edge of the umbilical crater, but in its gentle slope the axia riblets reappear, and in greater strength than they are posteriorly Aperture orbicular; peristome thin and continuous.

Dimensions of figured example.—Major diameter, 1·66; minor diameter, 1·1; height, ·95 mm.

Locality.—Fowler Bay, west coast of South Australia; collected by me in 1879.

Reticulated sculpture is rare in the family, and the peculiarity of its partial development in the present species is in itself a sufficiently distinctive character.

Doubtful Species of Cyclostrema.

Cyclostrema caperatum, *spec. nov.* Pl. vii., figs. 1 *a-b*.

Shell small, discoidal; diaphanous, though somewhat clouded around the umbilicus. Spire convex, slightly elevated; whorls four and a-half, inclusive of protoconch of one and a-half smooth whorls. The ordinary whorls slightly depressed at the posterior suture thence regularly subconvex, suture linear; all the whorls spirally lined, the linear ridges slightly narrower than the inter-

vening sulci about fourteen on the upper-surface of the body-whorl; the posterior one and a-half whorls ornamented by arched retroverted transverse folds; the last whorl abruptly rounded at the periphery to the flattened base, which is inconspicuously marked by concentric lineations.

Aperture roundly oval, a little wider than high, its vertical plane oblique to the axis of the shell; peristome incomplete; outer lip acute and medially ecurved; columellar lip nearly vertical, with truncated edge, and thickened at its junction with the basal lip. Umbilical orifice of moderate size, but exposing the penultimate whorl; umbilical crater with somewhat precipitous sides interrupted by a shallow spiral furrow.

Maximum diameter, 5; height, 2 mm.

Lakes Entrance Gippsland, Victoria, in shell-sand. Three examples collected by, and received from, Dr. Pulleine.

I am not satisfied that this new species is rightly placed in *Cyclostrema* or even in Cyclostrematidæ; the oblique aperture is not proper to *Cyclostrema*, whilst the spiral excavation around the umbilical crater, which recalls *Minolia* in Trochidæ and *Homalaxis* in Solariidæ (at least as represented by the species in the Parisian Eocene) is not known among Cyclostrematidæ. But I am at a loss where else to place it in the absence of characters which would be furnished by the animal or its operculum.

Supplemental Note.—The following extract from a letter (25/9/99) by Mr. C. Hedley, is of much interest regarding the systematic position of this species :—"Your *C. caperatum* I refer to the section *Solariorbis* of *Teinostoma*. The group is defined by Dall; briefly it is distinguished by an umbilical keel. The nearest ally of *caperatum* is *Starkeyæ*, N.S. Wales. A glance at the umbilicus serves to distinguish them, that of the latter being more choked by the umbilical keel; besides *caperatum* is striated; *Starkeyæ* smooth; *caperatum* absolutely larger and comparatively flatter."

Cyclostrema charopa, *spec. nov.* Pl. vii., figs. 2*a*-2*c*.

Cyclostrema micra, Petterd, Journ. Conch., p. 139, 1884 (non *C. micra*, Ten.-Woods, 1877).

Shell minute, planorbiform, very widely umbilicated, sordid-white; spire slightly sunken. Whorls four, rapidly increasing, convex; last whorl with a sloping sutural margin; the ornament consists of close-set, slender, oblique growth-lines only; base convex, abruptly bounding the wide umbilicus, which exposes all the whorls. Aperture incomplete, nearly circular, a little wider than high; outer lip sharp, ecurved medially.

Dimensions of figured specimen.—Minor diameter, 1·1; major diameter, 1·84; height, ·5 mm.

Habitat.—Tasmania (Petterd); South Australia (Dr. Verco).

The figured example, which I received from Mr. May, has been critically compared by me with Mr. Petterd's type, and is considered to be conspecific, though it is larger, and has an additional whorl, which has developed the sutural slope absent in the younger shell. This may not be a *Cyclostrema*, and I have been inclined to refer it to *Homalogyra*, but the simple aperture forbids such an attachment. The specific name is in allusion to the similitude of the shell to that of some species of the helicoid genus *Charopa*.

Cyclostrema Mayii, *spec. nov.* Pl. vi., figs. 4*a*-4*c*.

Shell minute, very fragile, discoidal, with a flat spire and rounded periphery, profundly and widely umbilicated. Protoconch large, oblong, and inflated. Spire-whorls two, slightly sloping to the channeled suture; ornamented by thick and somewhat irregular growth-folds, those on the body-whorl passing across the periphery to the umbilicus; the rounded periphery is faintly angled above and below, less so below than above. Aperture circular, peristome entire and simple.

Dimensions of figured example.—Major diameter, 1·1; minor diameter, ·84, height, ·4 mm.

Habitat.—Tasmania, received from Mr. W. L. May, of Sandford, in honour of whom I have employed the species-name.

This is another *Homalogyra*-like shell, but distinct from *C. charopa* in its flat, not sunken spire, coarse ornament, and complete peristome.

Section Tubiola.

Cyclostrema Angeli, *T.-Woods, sp.*

Rissoa (?) Angeli, Tenison-Woods, Proc. Roy. Soc., Tasmania, for 1876, p. 153 (1877); *id.*, *op. cit.*, p. 122, 1878.

This species seems congeneric with *C. conica*, Watson, "Voy. Challenger," of which Tryon remarks, "it is more like a *Scalaria*." Of Tenison-Woods' species, the same author says, "generic position doubtful;" though Tenison-Woods himself remarks, *op. cit.*, p. 122, "some authors would place the species in the genus *Cyclostrema*."

Habitat.—Tasmania (Blackman's Bay, ? type), my collection received from Mr. May; S. Australia, Dr. Verco.

Though Rissoia-like, yet by its fragile test, and in the absence of the opercular characters, it is better placed in Cyclostrematidæ, because of the thinness of the test.

Tryon figures a Tasmanian shell as *Rissoa Angeli*, but it is a distinct species, hereafter to be described.

The axial ornament of *R. Angeli* consists of thick ribs, about ten on the last whorl, which cease at the periphery. Ten.-

Woods' observation, "outer lip thickened," is not correct, as that appearance arises from the coincidence of the thick rib making the apertural margin, which it does not always do.

Cyclostrema crebresculptum, *spec. nov.* Pl. vii., fig. 5.

Syn.—*Rissoa Angeli*, Tryon, IX., p. 358, t. 71, f. 11 (original), non Ten.-Woods.

Umbilicated, turbinate-conical, thin, sordid-white. Whorls four, convex, with a well-impressed suture; ornamented with sharp, slender, crowded axial threads (30 or more on the last whorl, which extend on to the base), and by numerous interstitial spiral striæ. On the base the spiral striæ are as strong as the axial threads. Aperture circular, outer lip thin.

Dimensions of figured example.—Major diameter, ·9; minor diameter, ·76; height, ·9 mm.

Habitat.—Tasmania (received from Mr. May).

This species is distinguishable from *C. Angeli* by more turbinate outline, and by its numerous slender axial threads, which extend on to the base; the sculpture recalls *C. Johnstoni*, which is, however, a discoidal shell. I do not regard it as an adolescent state of *C. Angeli*, because the posterior whorls (at any rate the penultimate one) have the type of costation as on the body-whorl.

Tryon's figure shows, and his description states, "sharp rather crowded growth-lines," which are at variance with Woods' statement that the ribs are thick and distant; characters borne out by the study of authenticated specimens of his species. I do not know the source whence Tryon obtained the several Tasmanian Cyclostrematids which he so unsatisfactorily figured, and seems not to have taken the pains to verify the application of the species names which accompanied them. There can be no hesitation for the opinion that in the present case he was misled into an error of identification.

Cyclostrema australe. * *Angas, sp.*

Cirsonella australis, *Angas*, P.Z.S., 1877, p. 38, f. 16.

Teinostoma (Cirsonella) australis, *Tryon*, Man. Conch. X., p. 107, t. 35, f. 83-84 (copied), 1888; *id.* Henn. and Brazier, P.L.S., IX., p. 175, 1894.

Cyclostrema Weldii, *Tenison-Woods*, Proc. Roy. Soc., Tasm. for 1876, p. 147 (1877).

Cyclostrema (Tubiola) Weldii, *Tryon*, *op. cit.*, t. 33, f. 11, p. 95 (original), 1888.

Cirsonella Weldii, *Brazier*, P.L.S., IX., p. 698, 1895.

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* Cyclostrema is a neuter noun.

Cyclostrema Susonis, *Tenison-Woods, op. cit.*, p. 147, 1877.

Cyclostrema (Tubiola) Susonis, *Tryon, op. cit.*, p. 95, t. 33, f. 10 (original), 1888.

The three shells separately described as distinct species, namely, *Cyclostrema Weldii*, *C. Susonis*, and *Cirsonella australis*, are, in my judgment, conspecific. Their specific distinctness was not publicly challenged till 1895, when Brazier expressed the opinion that *Weldii* and *australis* were identical. Tyron, from his study of examples of the two Tasmanian species, follows Woods in their generic location, though further assigned them to the group *Tubiola*. With regard to Angas's *Cirsonella australis*, which it is evident he had no personal knowledge of, he was not so fortunate in the selection of a classificatory position for it. We, thus, had at this date the one species under two generic denominations. Brazier, following on, had to make choice of either *Cyclostrema* or *Tinostoma*, and very unhappily prefers the latter, retaining *Cirsonella* in subordination. That the species under consideration is not a *Tinostoma* but is a *Cyclostrema*, does not admit of argument; the distinctive characters of the two genera are too pronounced to make confusion possible. By comparison of authentic specimens of *C. Weldii* and *C. Susonis* with the type of *Cirsonella australis* preserved in the British Museum, I am able to confirm Brazier's suggestion that *C. Weldii* and *C. australis* are conspecific; but I differ from him as to the priority of the former name.

Tenison-Woods' paper containing a diagnosis of *C. Weldii* was read August, 1876, but was not published till 1877; that of Angas containing his *Cirsonella australis*, was read January 16, 1877, and was published early in that year. It may not be possible to ascertain definitely which publication appeared first, but as Angas's description is accompanied by figures, and Tenison-Woods's is not, preference should be given to his name, though, at the same time, Tenison-Woods's diagnosis is exact, whilst that of Angas is very superficial.

Brazier considers, moreover, that Tenison-Woods redescribed his *C. Weldii* as *C. immaculata*, but if he had consulted the diagnosis of that species he would have satisfied himself that not a single character is applicable to *C. Weldii*; in point of fact, *C. immaculata* is an immature *Liotia*, probably the shell so misnamed is *Cyclostrema Susonis*. I may add in this connection that the identification of Tenison-Woods's species is open to mistrust. I have had the same species communicated to me by different Tasmanian conchologists under three specific names representing three genera. This discord is largely attributable to the circumstances that the type examples in the Hobart Museum are not indicated, and that labels in some instances are

misplaced. These are facts which I have assured myself of, as regards certain cotypes labelled by Tenison-Woods most obligingly given me by Mr. Legrand, as they did not agree with the reputed types, and which I further found were at variance with the diagnoses. The quotation of *C. immaculata* under *C. Weldii* is evidently another case in point. Mr. Brazier trusted his correspondent, and his correspondent may have relied upon on the naming in the Hobart Museum; each believing their sources of information reliable, they have unwittingly perpetrated a grave error. Touching the identity of *C. Susonis* and *C. Weldii*, I may point out that the essential differences between these two so-called species, as indicated in Tenison-Woods's diagnoses, admit of explanation; they may be tabulated as follows :—

Weldii—diameters, 2 x 2 mm.; whorls six, growth lines present, umbilicus marginate.

Susonis—diameter, 1·5 mm.; whorls four, no ornament, umbilicus emarginate.

The smaller size and fewer whorls of *Susonis* indicate a younger shell. The spiral lines on the base of *Weldii* may be two or three; sometimes the one adjacent to the umbilical chink is more pronounced, in other examples the spirals are wanting. The presence or apparent absence of growth-lines may vary with the condition of the test. To sum up in the words of my correspondent, Mr. W. May, of Tasmania, "the margined umbilicus is not constant, but varies from several distinct grooves to perfect smoothness;" and, again, "I can see no difference between *C. Weldii* and *C. Susonis*"—opinions which I endorse, based on independent study of the species.

Specimens of *C. australe* in my cabinet, coming from New South Wales, Tasmania, and South Australia have the opercula preserved. The operculum is concave on the outer face, thin, translucent, of seven to eight whorls around a central nucleus, obliquely and distantly striated.

Habitat.—New South Wales (type of *Cirsonella australis*.'); Tasmania ! (types of *C. Weldii* and *C. Susonis*); South Australia, Streaky and Fowler Bays (R. Tate), St. Vincent Gulf (Dr. Verco !), Noarlunga and Macdonnell Bay (Mr. Adcock !).

Cyclostrema micron. *Ten.-Woods.*

1877, *C. micra*, Proc. Roy. Soc., Tasm. for 1876, p. 147.

Cyclostrema (*Tubiola*) *micra*, Tryon, Man. Conch., X., p. 95, t. 33, f. 13 (original).

This is more turbinate than *C. australe*. In addition to its Tasmanian habitat, it occurs in South Australia.

Cyclostrema contabulatum, *spec. nov.* Pl. vii., fig. 6.

Shell small, globosely turbinate, narrowly umbilicated, thin, translucent, smooth and shining; whorls four, convex, narrowly flattened at the suture, marked with fine oblique growth striæ. Body-whorl rounded at the periphery. Aperture slightly oblique, subcircular; peristome complete; columella-lip slightly arched and everted, somewhat concealing the small umbilicus.

Dimensions of figured example:—Major diam., 2·26; minor d am., 1·72; height, 2·28 mm.

Localities.—Streaky and Fowler Bays, abundant in shell-sand; also Salt Creek, St. Vincent Gulf.

This species is related to *C. micron*, but is narrowly umbilicated, and the whorls are shouldered.

Genus Lodderia, *Tate*, 1899.

Cyclostremella, Tate, 1898, non Bush, 1897.

Lodderia Lodderæ, *Petterd, sp.*

Liotia Lodderæ, Petterd, Journ. Conch., p. 135, 1884; *id.*, Hedley, Proc. Linn. Soc., N.S.W., vol. XXIII., 1899, p. 802; three woodcut figures.

Localities.—Tasmania (Petterd!); South Australia, Denial, Streaky, and Fowler Bays (R.T.), Port Victor and MacDonnell Bay (A. Adcock!); New South Wales, Sydney Harbour (C. Hedley!).

L. Lodderæ has the operculum and vitreous test of the Cyclostrematidæ.

From the observations of Messrs. Hedley and Pilsbry, *op. cit.*, *Vitrinella liricincta*, Garrett, is congeneric; and a third species may be the following.

Lodderia minima, *Ten.-Woods, sp.*

Liotia minima, T.-Woods, Proc. Roy. Soc., Victoria, 1877.

I have not seen this species, but from the description it would seem to be allied to *L. Lodderæ*. The habitat is not stated, but it is presumably either Tasmanian or Victorian.

Genus Pseudoliotia, *Tate*, 1898.

Pseudoliotia micans, *A. Adams, sp.*

Cyclostrema micans, A. Adams, P.Z.S., 1850; *id.*, A. Adams, Thes. Conch., t. 255, f. 7 and 27; *id.*, Tryon, Man. Conch., 1888, X., p. 88, t. 31, f. 17, 18 (copied).

Liotia Angasi, Crosse, Jour. de Conch., 1864, t. 13, f. 4; *id.*, Tryon, *op. cit.*, p. 110, t. 36, f. 4 (copied).

Liotia speciosa, Angas, P.Z.S., 1871, t. 1, f. 26; *id.*, Tryon, Man. Conch., X., p. 110, t. 36, f. 5 (copied).

Cyclostrema micans (including *Liotia Angasi*), Tate, Trans. Roy. Soc., S. Austr., XXI., p. 43, 1897.

Cyclostrema micans, var. *gracilior*, Tate, *op. cit.*, XXII., p. 71, 1898.

I have already indicated that my study of the types of *C. micans* and *L. Angasi*, which are in the British Museum, leads me unhesitatingly to declare them conspecific; though they have been treated as distinctive, both generically as well as specifically, by Tryon. Authenticated specimens of *L. speciosa*, received from the Australian Museum, are certainly congeneric with *C. micans*, and, in my judgment, belong to the micromorphic state of that species; and in slight decrescence of the ornament make an approach to the varietal form, which I have named *gracilior*. Tryon thought that *L. speciosa* would prove synonymous with *L. Angasi* (*op. cit.*, p. 110). The operculum of *Pseudoliotia micans* is horny, pellucid, nucleus central, four-whorled; the outer face is concave, obliquely and distantly ridged.

Distribution.—Japan (types of *C. micans!* and *C. pulchella*) and Singapore; S. Queensland (Brisbane Museum!); New South Wales (*L. Angasi!* and type of *L. speciosa!* by Angas); Victoria; Tasmania (*Tenison-Woods*); South Australia (type of *L. Angasi!*).

Pseudoliotia micans, var. Gowllandi.

Liotia Gowllandi, Brazier, P.Z.S., 1874, t. 83, f. 1-2; *id.*, Tryon, Man. Conch. X., p. 110, t. 36, f. 7-8 (copied).

According to Tryon this species appears to him "to be synonymous [with *L. speciosa*], judging from description and figure." Certainly they are not helpful to a solution of the validity of the species, but thanks to Mr. Hedley I have received four specimens of Brazier's shell, which permit me to offer the following observations:—*L. Gowllandi* is a micromorph, and like other small states of *C. micans* (as *var. gracilior* and *speciosa*) has only two keels instead of three on the upper surface of the body-whorl; moreover, there is a tendency to fusion of the two peripheral keels and to obliteration of the basal rib, and in consequence of the latter feature the threads on the base radiate uninterruptedly from the periphery to the keel. The same form occurs at Western Port, but of the many examples of it under observation some show variability in this particular towards differentiation of the keels.

Localities.—Percy Island, N.E. coast of Australia (Brazier's type); Milne Bay, New Guinea (C. Hedley!); Port Western, Victoria (R. Tate!).

List of species attributed to Cyclostrematidæ recorded as Australian.

Names previously recorded.	Names adopted.
Angeli (Rissoa), *Ten. Woods.*	Cyclostrema Angeli.
Angeli (Rissoa), *Tryon.*	Cyclostrema crebresculptum.
Australis (Cirsonella), *Angas.*	Cyclostrema australe.
*Brunniensis, *Beddome.*	Skenea? Brunniensis.
Cingulifera, *A. Adams.*	Not Australian.
Harriettæ, *Petterd.*	Cyclostrema Harriettæ.
Immaculata, *Ten.-Woods.*	Liotia sp. (juv.).
Johnstoni, *Beddome.*	Cyclostrema Johnstoni.
Josephi, *Ten.-Woods.*	Collonia Josephi.
Lævis, *Kiener.*	Not Australian.
Lodderæ, *Petterd.*	Lodderia Lodderæ.
Micans, *A. Adams.*	Pseudoliotia micans.
Micra, *Ten.-Woods.*	Cyclostrema micron.
Micra, *Petterd.*	Cyclostrema charopa.
Minima (Liotia), *Ten.-Woods.*	Lodderia minima.
Spinosa, *Ten.-Woods.*	Astralium sp. (juv.).
Susonis, *Ten.-Woods.*	Cyclostrema australe.
Tatei, *Angas.*	Cyclostrema Tatei.
Weldii, *Ten.-Woods.*	Cyclostrema australe.

FAMILY LIOTIIDÆ.

Genus Liotia, *Gray*, 1842.

Tryon in his Manual of Conchology adopts the section *Liotina*, and refers to it as its sole living representative our *L. australis*, but in doing so he has misapplied certain distinctive features attributed to *Liotina* which are not possessed by *L. australis*.

Liotina was established by Munier-Chalmas in 1877 (*fide* Fischer) for the reception of *L. Gervillei*, Defrance, and two other Eocene species of the Paris-Basin. The salient characters claimed for it are :—"Shell not nacreous interiorly, umbilicus with a tuberculose funiculus." Aperture "not nacreous" does apply to the species of the Paris-Basin, rather as a consequence of fossilization than that they were originally so, in the same way that a much-bleached beach example of *L. australis* will have lost its nacre. However, the phrase is most certainly not applicable, as implied by Tryon, to fresh specimens of *L. australis*.

Again, I find that the several species of *Liotia* actually known to me have, at least in the adult stage, a spiral funiculus in th

* From Mr. May I have received an authentic example of Beddome' shell ; it has not the aspect of a *Cyclostrema*, and its two and a-half whorl are suggestive of an embryonic or very juvenile stage ; I am unable to locate it generically. Mr. May remarks, *in litteris*, on its resemblance to *Skenea planorbis*.

umbilical crater. However, it is not tuberculose as in the fossil *L. Gervillei*, but is dentated in *L. australis* and *L. Tasmanica*, and crenated in *L. clathrata*, *L. subquadrata*, and *L. Mayana*.

I fail, therefore, to appreciate the alleged differences which separate *Liotina* from *Liotia*; the differences presented by the umbilical funiculus are specific only, whilst the non-nacreous attribute is more apparent than real.

Liotia australis, *Kiener, sp.*

Reference.—Iconog., t. 4, f. 7 (Delphinula); *id.*, Reeve, Icon-Conch. (Monograph of Delphinula), f. 20, 1843.

Kiener's type was collected by Peron (Baudin Expedition) at St. Pierre and St Francis Isles in South Australia, and cotypes are referred to the Phillippines. The species is common in South Australian waters, I know it from Victoria, and it is recorded for Tasmania by Tenison-Woods.

L. australis has an operculum proper to the genus. The anterior thickening of the columella is decurrent on the umbilical rim, and the spiral funiculus is sharply dentated on the edge. The species exhibits great variability in size of the adult, the adult stage being indicated by the largely thickened aperture, thus a macromorph has a maximum diameter of 12 mm., an extreme micromorph 4·5, whilst these two are linked by intermediate sizes.

Liotia annulata, *Ten.-Woods.* Pl. vi., figs. 7*a*-7*b*.

Reference.—Proc. Roy. Soc. Tasm., for 1877, p. 121, 1878; *id.*, Tryon, Man. Conch., X., p. 111, t. 36, f. 20 (original).

Synonym.—*Liotia compacta*, Petterd, Jour. Conch., 1884, p. 135.

I have examples from Tasmania and Corio Bay (J. Mulder), Victoria, which agree in the chief particulars with Tenison-Woods's description and Tryon's figure of *L. annulata*; but all are without completed apertures, are minute or small sized and few-whorled, and are presumably immature, or have not yet acquired the characteristic apertural conformation of an adult *Liotia;* however, the inner shell layer is nacreous, and the generic location is probably correct. It is neither the young of *L. australis*, as has been suggested, nor that of any of our Southern species. *L. australis* at 3 mm. diameter has a strong cancellate ornament; *L. Tasmanica* of the same size, which on account of its planorbiform shape most resembles *L. annulata*, has transverse frills developed on the periphery only and is without spiral lineation.

A feature omitted by Tenison-Woods and Tryon, which is exhibited by an example of 3 mills diameter, is the possession of three linear ridges on the periphery of the last whorl, which are

rendered distinct by the slight vaulting of the erect lamellæ at the intercrossing. Ten-Woods does not describe the periphery, and Tryon's figure shows the periphery uninterruptedly convex; and as his example has a diameter of 1.5 mm. only, it is clear that the peripheral lineation is acquired at a more advanced stage of growth; Petterd's type of *L. compacta*, which measures $1\frac{1}{4}$ mills, is similar.

The type of *L. compacta*, which I figure, as also all other examples seen by me and considered conspecific, is ornamented with transverse striæ between the ribs; on the other hand, Ten.-Woods says of his *L. annulata*, the "interstices smooth." In all other respects the two shells are identical, and to reconcile the discrepancy in their diagnoses, it may be assumed that "smooth" as applied by Ten.-Woods refers to the appearance as seen by the unaided eye. Petterd's character, "aperture expanded," conveys a false impression; Ten.-Woods's observation is the correct one, "aperture bearing a varix round the mouth like one of the rings of the spire," and notes "the aperture has hardly that thickening which we observe generally in the genus,"

Liotia Tasmanica, *Ten.-Woods.*

1865. *Liotia siderea*, Angas (list-name), P.Z.S., p. 178 (non Reeve).

1876. *Liotia Tasmanica*, Ten.-Woods, Proc. Roy. Soc., Tasm., for 1875, p. 153.

1895. *Liotia Tasmanica*, Hedley, P.L.S., N.S. Wales, vol. IX., p. 465, three woodcuts.

The South Australian shell which has been so long known as *L. siderea* is not Reeve's species, as I have satisfied myself by comparison with his type in the British Museum; they have much resemblance, but the Philippine shell has in particular a much more ample body-whorl. An immature shell of *L. Tasmanica*, all that I have seen, is identically that of the earlier whorls of the South Australian so-called *siderea*, whilst Hedley's figures of the Tasmanian shell remove all doubt as to the identity of the two. *L. siderea*, Reeve, is therefore expunged from the Australian fauna, as the only published occurrence of it is the faulty one by Angas. Tenison-Woods in his description compares his new species with *L. discoidea*, but in this regard an error of determination has been committed, as the Tasmanian shell of that name is not Reeve's species. The test and operculum of *L. Tasmanica* have the characteristics of the genus.

Liotia calliglypta, *Melvill.*

Reference.—Journ. Conch., VI., t. 2, f. 10, p. 410, 1891.

The type was taken at Thursday Island, North Australia.

This may not be a *Liotia*, as "labro exteriori subreflexo" does not apply in the genus unless the shell is at that stage when the variced lip is commencing to be formed.

Liotia clathrata, *Reeve, sp.*

Reference.—Icon. Conch. (Delphinula), f. 21.

The type is from the Philippines, and Reeve adds Australia. I have examples from New South Wales (ex. Aust. Mus.) and Queensland (ex. Brisbane Mus.); the operculum is *Liotian.*

Liotia discoidea, *Reeve, sp.*

Reference.—Op. cit., f. 15.

A Philippine shell, but has been recorded from North Australia.

Liotia muricata, *Reeve, sp.*

Reference.—Op. cit., f. 18.

Another Philippine shell extending to North Australia.

Liotia Mayana, *spec. nov.* Pl. vi., figs. 5*a*-5*c*.

Syn.—L. discoidea, Ten.-Woods, Proc. Roy. Soc., Tasm., for 1877, p. 39, 1878, non Reeve.

I have had under examination Tasmanian examples attributed to *L. discoidea*, Reeve, but fail to recognise in them the distinctive characters of that species, as indicated by diagnosis and illustrations of it; especially is inapplicable "periphery with two prominent ribs," and the ornament of the base is different. The same species has been dredged by Dr. Verco in some abundance in South Australian waters.

In size and general appearance it resembles *L. subquadrata*, but the suture is not excavated, the aperture not so explanulately thickened, and its columella-margin is detached from the umbilical rim.

Its affinity is, however, greater with *L. clathrata* (actual examples compared) which has three liræ of equal size on the periphery instead of gradually diminishing in strength from above downwards, the costæ are more elevated, imbricating, and closer. In *L. Mayana* the last whorl is more rounded, keels less elevated, with four instead of three on the periphery; posterior whorls with three, not two, keels; keel at the suture nodular, not spinulose.

Habitat.—Tasmania, the species is rare; Victoria, South Australia (St. Vincent and Spencer Gulfs, and Fowler Bay, not uncommon in shell-sand).

Liotia subquadrata, *Ten.-Woods.*

1877. *Cyclostrema immaculata*, Tenison-Woods. Proc. Roy. Soc.. Tasm., for 1876, p. 148.

1877. *Liotia lamellosa* (pars.), Ten.-Woods, op. cit., p. 96.

1878. *Liotia subquadrata*, Ten.-Woods, P.L.S., N.S. Wales, ii., p. 236.

As already pointed out *Cyclostrema immaculata* was founded on a very immature condition (3 mm. diam.) of a Liotia, the adult form being presumably *L. subquadrata*; the absolute inadequacy of the diagnosis makes it desirable to suppress the name. In the same year the author described a Table Cape fossil as *L. lamellosa*, and in an appended note stated that a living example had been dredged off the Tasmanian coast. On comparison of the recent and fossil specimens I found differential characters to obtain such as are set forth in P.L.S. ii., p. 236, wherein Mr. Woods has applied the name of *L. subquadrata* to the living species.

Habitat.—Tasmania! and South Australia!; a rare shell, Middleton and Macdonnell Bay (A. Adcock!).

Liotia densilineata, *spec. nov.*

This species has the general aspect of an immature *L. australis*; the revolving liræ are almost obsolete, wholly so on the base; the transverse threadlets are depressed, very numerous, and crowded so as to obliterate entirely the cancellate ornament; the axial threadlets are fasiculated at both sutures giving rise to a corona on the anterior whorls and subspinose developments on the earlier ones; the umbilicus is large, its margin coronated by the fasciculation of the transverse threadlets. Aperture circular, outer margin slightly dilated but not varicose (the shell is probably not yet adult); columella margin is detached from the umbilical rim; the operculum is that proper to *Liotia*.

In *L. subquadrata*, the transverse ornament consists also of fine threadlets, but its revolving ridges are few and bold, imparting a quadrate outline to the last whorl.

Max. diam., 7; min. diam., 5; height, 4·5.

Habitat. — D'Entrecasteaux Channel, Tasmania (very rare). One example received from Mr. W. L. May, which is much corroded, and altogether its condition does not permit of a satisfactory pictorial representation.

List of Species-names Excluded or Synonymic.

Angasi, Crosse = Pseudoliotia micans.
Compacta, Petterd = L. annulata.
Discoidea, Ten.-Woods = L. Mayana.
Gowllandi, Brazier, is a Pseudoliotia.
Loddercæ, Petterd, is a Lodderia.
Minima, Ten.-Woods, is a Lodderia.

Peroni, Kiener (Delphinula), is not Australian.*
Siderea, Angas = L. Tasmanica.
Speciosa, Angas = Pseudoliotia micans.

Species Dubious.

Incerta, Ten.-Woods, Proc. Roy. Soc., Tasm., for 1876, 1877 p. 148.

Mr. Petterd, 1888, regarded this shell as an immature *Astralium Tasmanicum*, but this cannot be correct, as, except "nacreous," none of the characters of *L. incerta* apply to a young shell of *Astralium Tasmanicum = aureum*, of 5 mm. diameter. On the other hand, Mr. Legrand states that it is a decided species of *Liotia*, whilst the author of the species writes, *op. cit.*, "I only provisionally class it as a *Liotia*." I incline to the opinion that it is an immature *L. Tasmanica*. In any case, it will be well to suppress the name.

* This shell is recorded from the Indo-Pacific regions, whilst the type is attributed by Peron to the Isles St. Pierre and St. Francis, off the coast of Western South Australia. That locality is the only Australian record known to me; it should be rejected, not only on that account, but also because it and other well-known species of the tropics attributed to the same locality by Peron, such as *Tellina capsoides*, *Isocardia semisulcata*, &c., have not been rediscovered in our temperate waters.